

WHAT IS CLAIMED IS:

1                   1.       A method of duplicating data in a system provided with a first storage  
2 subsystem group, comprising a first plurality of storage subsystems, and a second storage  
3 subsystem group, comprising a second plurality of storage subsystems,  
4                   wherein the storage subsystems of the second storage subsystem group store  
5 copies of the data of the first storage subsystem group,  
6                   wherein each of the storage subsystems of the first storage subsystem group  
7 writes the data into a storage device of the first storage subsystem group, assigns a serial  
8 number and a time, and transfers the data through a transmission line to at least one of the  
9 second plurality of storage subsystems of the second storage subsystem group, and  
10                  wherein a plurality of data received by each of the storage subsystems of the  
11 second storage subsystem group is arranged sequentially based on the serial numbers, and  
12                  wherein an oldest time is decided from among the a plurality of latest times by  
13 each of storage subsystems of the second storage subsystem group, each latest time being  
14 related to the plurality of data arranged based on the serial numbers, each latest time being  
15 communicated between at least some of the storage subsystems of the second storage  
16 subsystem group, and  
17                  wherein data that is related to a time not later than the decided oldest time are  
18 selected as data to be written to the storage device of each of the storage subsystems of the  
19 second storage subsystem group.

1                   2.       The method of duplicating data as claimed in claim 1, wherein said  
2 transmission line that connects a storage subsystem which belongs to said first storage  
3 subsystem group and a storage subsystem which belongs to said second storage subsystem  
4 group comprises a Storage Area Network (SAN).

1                   3.       The method of duplicating data as claimed in claim 1, wherein a clock  
2 providing said time to each of the storage subsystems of said first storage subsystem group is  
3 corrected by an external source of time information.

1                   4.       The method of duplicating data as claimed in claim 1, wherein  
2 connections among the storage subsystems of said second storage subsystem group are made  
3 by loop transmission lines, and wherein each of the storage subsystems informs other storage  
4 subsystems of a latest time from among times associated with individual data copies stored

5 within said storage subsystem, and thereupon, an oldest time is determined from among the  
6 latest times of each of the storage subsystems in said second storage subsystem group.

1 5. The method of duplicating data as claimed in claim 1, wherein one of  
2 the plurality of storage subsystems which belongs to said second storage subsystem group is  
3 set as a master storage subsystem, and wherein each of the storage subsystems, other than the  
4 master storage subsystem, notifies the master storage subsystem of a latest time of data in  
5 each of said other storage subsystems, and the master storage subsystem decides said oldest  
6 time from among said latest time of data in each of said other storage subsystems and a latest  
7 time of data stored in said master storage subsystem.

1 6. The method of duplicating data as claimed in claim 1, wherein a  
2 plurality of storage subsystems of said first storage subsystem group transfer each of writing  
3 data to one of the storage subsystems of said second storage subsystem group, the one of the  
4 storage subsystems of the second storage subsystem group selects the latest time that is given  
5 to each of said storage subsystems of the first storage subsystem group and decides the oldest  
6 time from among the selected latest times.

1 7. The method of duplicating data as claimed in claim 1, wherein a  
2 storage device of said storage subsystem is comprised of volumes and a volume pair is  
3 comprised of a volume of the first storage subsystem group and a volume of the second  
4 storage subsystem group, the storage subsystem which belongs to the first storage subsystem  
5 group controls a start and a stop of data transmission to the second storage subsystem group  
6 with the unit of each of the volume groups comprised of a plurality of volume pairs.

1 8. A data duplicating system, comprising:  
2 a first storage subsystem group comprising a plurality of first storage  
3 subsystems; and  
4 a second storage subsystem group comprising a plurality of second storage  
5 subsystems that store copies of the data of the first storage subsystem group,  
6 wherein each of the first storage subsystems comprises a means of writing data  
7 to a storage device of the storage subsystem, a means of giving a serial number and a time to  
8 said data, a means of transmitting said data with the serial number and the time through a  
9 transmission line to the storage subsystem of the second storage subsystem group,

10                    wherein each of the second storage subsystems comprises a means for  
11    arranging the received plurality of data in sequence based on said serial numbers, a means for  
12    deciding an oldest time from among a plurality of latest times associated with the second  
13    storage subsystems by the communicating the latest time from at least some of the second  
14    storage subsystems to the other second storage subsystems, and a means of writing the data  
15    with a time not later than a decided oldest time to a storage device of each of the second  
16    storage subsystems,  
17                    each latest time in a second storage subsystem being related to the times of the  
18    plurality of data arranged based on the associated serial numbers.

1                    9.        A data duplicating system as claimed in claim 8, wherein said  
2    transmission line comprises a Storage Area Network (SAN).

1                    10.       A data duplicating system as claimed in claim 8, wherein each of the  
2    first storage subsystems is provided with a means for correcting a clock for referring to said  
3    time from external time information.

1                    11.       A data duplicating system as claimed in claim 8, wherein connections  
2    among the second storage subsystems are made by a loop transmission line and each of the  
3    second storage subsystems transfers an older of its latest time and a latest time received from  
4    another of the second storage subsystems to an adjacent one of the second storage  
5    subsystems, the data duplicating system further comprising means of deciding the time  
6    transferred by the second storage subsystem and returned to the second storage subsystem as  
7    said oldest time.

1                    12.       A data duplicating system as claimed in claim 8, wherein one of the  
2    second storage subsystems is configured as a master storage subsystem, each of the second  
3    storage subsystems other than said master storage subsystem comprises a means of notifying  
4    its latest time to the master storage subsystem and said master storage subsystem is provided  
5    with the means of deciding said oldest time from among its latest time and the latest times  
6    received from second storage subsystems other than said master storage subsystem.

1                    13.       A data duplicating system as claimed in claim 8, wherein a plurality of  
2    the first storage subsystems are comprised to transfer each of the writing data to one of  
3    second the storage subsystems and said one of the second storage subsystems comprises a  
4    means of selecting a latest time given to each of said first storage subsystems and a means of

5 determining an oldest time from among the selected latest time as the candidates of said  
6 oldest time.

1 14. A data duplicating system as claimed in claim 8, wherein the first and  
2 second storage subsystem groups each comprises a plurality of volumes, wherein a volume of  
3 the first storage subsystem group is a source of copying and a volume of the second storage  
4 subsystem group is destination of copying and together form a volume pair, wherein one of  
5 the first storage subsystems is provided with a means for controlling the start and stop of the  
6 data transmission between volumes of a volume pair.

1 15. A storage subsystem, wherein a storage subsystem belongs to a storage  
2 subsystem group comprising a plurality of storage subsystems and said storage subsystem  
3 being provided with a first means of writing data received from outside to the storage device  
4 of the storage subsystem, a second means of transmitting said data being given a serial  
5 number and a time to other storage subsystems, a third means of arranging a plurality of data  
6 received from other storage subsystems in sequence of said serial numbers, and a fourth  
7 means of deciding the oldest time among the kinds of latest time given to each of the storage  
8 subsystems by communicating at least some of the latest times among the other storage  
9 subsystems, operates the first means and the second means when said storage subsystem is in  
10 local mode, and decides the data given with the time not later than the decided oldest time as  
11 the object of writing data by the first means operating the third means, the fourth means, and  
12 the first means at the remote mode.

1 16. A storage subsystem as claimed in claim 15, wherein said storage  
2 subsystem operating in said local mode is connected with said storage subsystem operating in  
3 said remote mode through a Storage Area Network (SAN).

1 17. A storage subsystem as claimed in claim 15, wherein said storage  
2 subsystem comprises a means for correcting a clock which is for referring to said time by  
3 time information from an external source.

1 18. A storage subsystem as claimed in claim 15, wherein a loop  
2 transmission line connects among said storage subsystems operating in said remote mode and  
3 each of the storage subsystems in said remote mode comprises a means of transmitting the  
4 older time among said own latest time and received said latest time to an adjacent storage

5 subsystem and a means of deciding the time transferred by the own storage subsystem and  
6 returned to the own storage subsystem as said oldest time.

1 19. A storage subsystem as claimed in claim 15, wherein one of said  
2 storage subsystems which operates in said remote mode is arranged as a master storage  
3 subsystem, each of the storage subsystems other than said master storage subsystem  
4 comprises a means for notifying said latest time to said master storage subsystem and said  
5 master storage subsystem comprises a means of deciding said oldest time out of own latest  
6 time and acquired latest time.

1 20. A storage subsystem as claimed in claim 15, wherein a plurality of  
2 storage subsystems which operate in said local mode are structured to transfer the data to one  
3 of the storage subsystems belonging to the storage subsystem group which operates in said  
4 remote mode, and said one of the storage subsystems belonging to the storage subsystem  
5 group which operates in said remote mode comprises a means of selecting the latest time  
6 given to each of the storage subsystems which operates in said local mode and a means of  
7 deciding the oldest time among the selected latest times as the candidates of said oldest time.

1 21. A storage subsystem as claimed in claim 15, wherein the storage  
2 device of said storage subsystems comprises a plurality of volumes and when a volume  
3 belonging to the storage subsystem which is the source of copying operating in said local  
4 mode and a volume belonging to the storage subsystem which is the destination of copying  
5 operating in said remote mode form a volume pair, the storage subsystem operating in said  
6 local mode comprises a means of controlling the start and stop of the data transmission to the  
7 storage subsystem operating in said remote mode for each of volume groups comprising one  
8 or more volume pairs.

1 22. A method for duplicating data in a plurality of disk subsystems, said  
2 method comprising:  
3 receiving a plurality of data;  
4 associating a time of receipt and a serial number with each of said plurality of  
5 data;  
6 at each disk subsystem, determining a most recent time from among data  
7 received, and communicating said most recent time to at least another of said disk  
8 subsystems to form a plurality of data having a most recent time;

9                   determining from said plurality of data having a most recent time, a data  
10   having an oldest most recent time; and  
11                   writing data having a time prior to said oldest most recent time to storage.